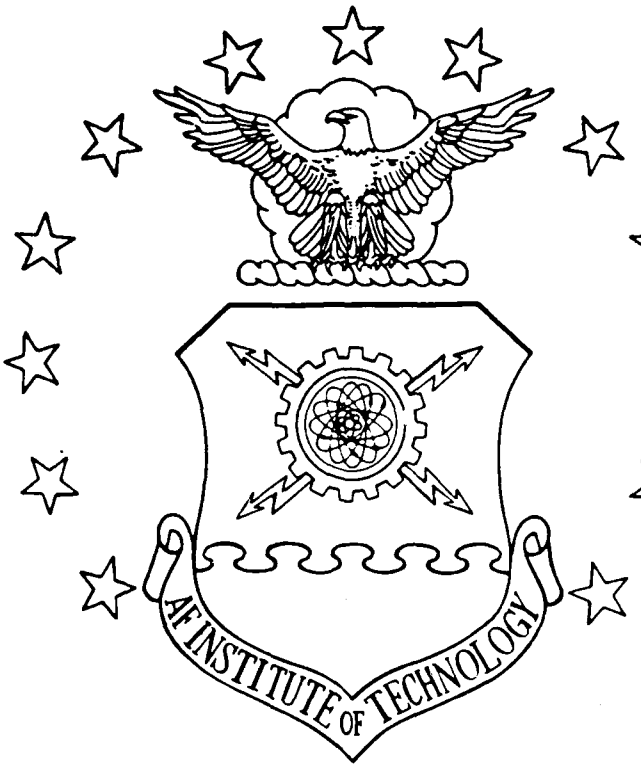

DEPARTMENT OF THE AIR FORCE

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PROJECT PETROL RAM:
IMPROVING THE MANAGEMENT OF AIR FORCE FUELS OPERATIONS AND INVENTORIES

THESIS

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AFIT/GLM/LSM/88S-20

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THESIS

Presented to the Faculty of the School of Systems and
Logistics of the Air Force Institute of Technology
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Captain, USAF

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Phillip R. Frederick

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Abstract

The purpose of this research was to provide a handbook on Project PETROL RAM and its ideas for enhancing the base-level fuels operation. This handbook is to serve as an introduction and reference guide to the components, characteristics, and capabilities of the proposed initiative.

In preparing this handbook, available information on the structure, operations, and procedures of a typical base Fuels Management Branch was gathered and summarized. Available data on the proposed systems was also gathered, then condensed and simplified. For added depth and understanding, personal interviews with personnel involved in the design and development of this project were conducted.

The research resulted in a handbook which describes, in simplified terminology, the different systems which are being developed under the Project PETROL RAM initiative. During the development of this handbook, indications that PETROL RAM will vastly improve the ability to account for and control vital fuel stocks were found. By decreasing the number of required forms, streamlining operational procedures, and eliminating redundant, time-consuming procedures, the support capability of the Base Fuels Management Branch will be greatly enhanced.

PROJECT PETROL RAM:
IMPROVING THE MANAGEMENT OF AIR FORCE FUELS OPERATIONS AND INVENTORIES

I. Introduction

Each year, billions of dollars are spent by the Department of Defense (DOD) on the purchase of petroleum products required to support its fighting forces throughout the world. In fiscal year 1986 alone, well over six billion dollars were obligated toward the procurement of jet fuels, ground products (gasoline and diesel), oils, and other petroleum products required to support the military vehicles and equipment of the United States' armed forces (1:22). The single largest user of these petroleum products is, without question, the U.S. Air Force. Of the total FY 1986 DOD consumption of 7.9 billion gallons, over 4.25 billion gallons were consumed in the support of the operations and equipment of the Air Force (1:16). Petroleum products are also used in powering Naval ships and aircraft, aircraft and equipment of the U.S. Army, ground vehicles of all of the services, and various other miscellaneous functions such as heating plants. In fact, every U.S. military installation or site, no matter how small or remote, consumes petroleum products in one way or another (18:3).

It is apparent that, without these petroleum products, especially jet fuel, the U.S. Air Force would not be able to perform its primary mission--to "fly and fight." While the necessity of these products is readily apparent to even the most casual observer, the procedures currently used to manage and control these vital products are, according to the Air Force Inspector General, inefficient, redundant, labor intensive, and inaccurate (13:4; 14). Obviously, an efficient, cost effective method to distribute and account for these large fuel inventories is needed to ensure that losses of these products (due to theft, spillage, leaking tanks, erroneous accounting procedures, etc.) are minimized.

In response to this need for improvement, Project PETROL RAM was begun. PETROL RAM, which stands for Petroleum Resources Automated Management, is an Air Staff initiative designed to develop methods to enhance and automate all aspects of the Air Force's fuels operations. Currently, five systems to improve the receipt, storage, distribution, and accounting procedures at base level fuels operations have been identified and grouped together under the "umbrella" of the Fuels Automated Management System (FAMS). These five systems are currently undergoing prototype testing at several different bases located throughout the continental United States (14).

Problem Statement

In keeping with current government policy, several different contractors, or companies, are involved in the design and testing of these various systems. This, tied with the fact that several different Air Force operating agencies are serving as "project monitors" for the different phases, means that, in the four years the project has been underway, many different reports and test results on both PETROL RAM and FAMS have been generated (13:6-12). Included in this vast amount of paperwork are many in-depth, technical explanations and descriptions of each system, its different components, and how each component works.

While much information on each of these proposed systems is available in one form or another, much of it is, as stated earlier, highly technical in nature. While this may be useful and extremely informative to the minority who possess the capability and interest to read and understand these technical reports, the fact remains that the vast majority of fuels personnel (both AFSC 631XX and 64XX) and other interested parties Air Force-wide possess neither the required knowledge nor inclination to "wade through" these reports. What is needed, then, is a single source where the "layman" can go to get a simplified, easy to understand explanation of the various systems and the operational capabilities of each. It should be noted that the term "layman" can refer to anyone from the young airman newly

assigned to the fuels career field to major command (MAJCOM) commanders who need to be kept abreast of advances or developments in support capability. The problem, then, was to produce and distribute such a reference, or "handbook," on the proposed systems. To accomplish this, it was necessary to obtain as much pertinent information on the systems as was possible, consolidate and simplify it, and then condense it into a useful product. This produced a handbook which explains, in simplified, easy-to-understand language and terminology, not only the different components of each of the systems, but also how each will work.

Scope

In producing this handbook, the history of the problem was researched to determine where the need developed--in other words, why is there a need for a new system? Then, by compiling available data, this paper answered the following questions:

1. What components make up the new system? This was a general overview of the five different programs or parts which will comprise the "total package."

2. How does the system work? This area was a more in-depth explanation of what the capabilities of the new system are and a general description of how to use the new technology.

3. How will the system make the job of the fuels specialist (personnel with AFSC 631XX) easier? Here

the concentration was placed on those aspects of the system which should reduce the amount of manual labor required to perform fuels-related tasks and thus provide for more efficient operations.

4. Is the new system actually "better" than the current system? Research in this area basically looked at the new procedures to determine if, in fact, the proposed system will enhance the ability of the Air Force in general to better account for and control its fuel stocks.

In answering these questions, advantages of the new systems were shown, and potential weaknesses of the proposed system were identified. To answer many of these questions, an explanation of the current methods of performing and controlling fuels operations and a comparison of these to the proposed system was necessary. However, this explanation did not go into great depth, but merely "scratches the surface" of what actually goes on in day-to-day base-level fuels operations. As stated before, the handbook is more an explanation and description of how the system will work rather than a defense of its necessity.

Purpose

As with any form of change, there is bound to be resistance to, and negativity toward, the new system and procedures. Therefore, the major objective of this research was to produce a handbook which will increase the

general knowledge of those people most affected by the change. Through use of this handbook, the "man in the field" will be able to understand the advantages and benefits of the new systems. Strictly from a selfish standpoint, this should increase his acceptance of the advances which are to take place in the coming years. This, it is hoped, will make for a smoother transition from the current methods to the proposed systems Air Force-wide.

II. Literature Review

In conducting this literature review, the first step taken was a review of available regulations, technical orders, and other reports and printed handbooks to determine what, exactly, the duties and responsibilities of the each of the various sections in a typical Base Fuels Management Office (BFMO) are and how they interact to accomplish the primary mission of that organization. In addition, "locally developed" checklists and operating instructions (OIs), from the author's previous bases, as well as from other bases in the continental United States, were used to determine in what sequence the procedures used in accomplishing various specific operations were performed. This was necessary to determine which of these operations would be specifically affected or enhanced by the proposed systems.

Literature on the capabilities, design, and function of the proposed system was harder to come by; however, technical reports, point papers, slide presentations, and other such material was available and researched to glean as much information as possible. In addition, the author relied heavily on telephone interviews with people actively involved in the design of these systems in order to ensure an accurate portrayal of each of the systems' capabilities. These interviews were also very helpful in

gathering information on proposed future enhancements, especially those not currently in the test phase. These future enhancements are being investigated for possible implementation in the coming years.

As mentioned earlier, the main focus of this literature review was to examine a current BFMO operation and it's daily operations, identify areas which could possibly be improved upon, and then to determine if the new system will solve the problem areas which have been identified. To accomplish this, the review was separated into these distinct parts:

1. A discussion of the different sections which comprise a BFMO and the basic responsibilities of each;

2. A brief discussion of the daily operations each section must perform, concentrating mainly on the extensive use of manual labor and calculations;

3. A brief overview of the proposed system and an explanation of the function and capabilities of each sub-system; and

4. A brief overview of other areas which are being considered for automation and may be implemented in the years to come.

Base Fuels Management Office Organizational Structure

The mission of each base-level Fuels Management Office is to "provide quality petroleum products, cryogenic fluids, missile propellants, and other

designated products to customers in a safe and efficient manner" (5:15). To accomplish this mission, the BFMO is divided into five sections. These are Fuels Management, Fuels Operations, Accounting and Administration, Quality Control and Inspection, and Training and Mobility. The following is a brief look at the function and responsibilities of each.

The Fuels Management section is made up of the Fuels Management Officer (FMO) and the Fuels Superintendent. This "two-person team" (5:23) has overall responsibility for all aspects of the fuels organization, from the requisitioning and management of all fuel stocks to the training of all assigned personnel. While it is not necessary to be an officer to be assigned as a base-level Fuels Management Officer, any person who is assigned to this position must receive specialized training at the Fuels Management Officer Course. This five week school is located at Chanute Air Force Base (AFB), Illinois. The FMO usually works directly for the Chief of Supply and is the accountable officer for all fuels, refueling equipment, and facilities in the branch (5:23-28; 15:3).

The Fuels Operations section is, in virtually every instance, the largest section of the branch and is the one directly responsible for aircraft refueling and mission support. This section is made up of three distinct subsections: the Fuels Control Center (FCC), Fuels

Distribution, and Fuels Storage. Since "the fuels operations supervisor is responsible for overall supervision of all resources used in the receipt, storage, transfer, and issue of fuel and other (fuel) related products" (5:58), this person must ensure the smooth interaction between these three subsections. This supervisor is usually the second highest ranking noncommissioned officer (NCO) in the branch, behind the Fuels Superintendent (15:6; 5:58).

The center of this section, the Fuels Control Center, is "the focal point for the planning, coordinating, scheduling, directing, and controlling of the Fuels operations" (15:5). This unit, which operates 24 hours a day, 7 days a week, is responsible for not only ensuring the prompt and safe accomplishment of all mission support activities, but is also responsible for monitoring all product movements, equipment status, inventory levels, personnel status, and all other information vital to the accomplishment of the BFMO mission (15:5; 5:58-63).

The Fuels Storage unit is responsible for the receipt and storage of all fuel inventories on base. This section consists of Bulk Storage, the Service Station, and a Cryogenics Storage unit. A major part of this section's duties includes maintaining effective inventory control procedures for all petroleum products on base, including tank gauging, leak testing, and other related duties.

Personnel assigned to this section must also be trained and qualified to perform servicing operations on aircraft during peak workloads (15:5; 5:70-72; 8:4).

Personnel assigned to the Fuels Distribution unit are responsible for not only the delivery of fuel to the aircraft, ground equipment, and organizational tanks, but also for preventative operators maintenance on all refueling equipment, demineralized water delivery to aircraft, and issues to tanks which are used to run heating plants around the base. This unit usually consists of three highly interrelated divisions: Mobile Refueling, Hydrant Refueling, and Preventive Maintenance (5:63-70; 15:6; 9:all).

The next major section of the Fuels Branch is Accounting and Administration. As the name implies, this section is responsible for maintaining all documentation concerning fuels transactions, as well as the administrative support of the entire branch. In this capacity, personnel assigned to this section must compute fuel requirements, monitor war readiness stockage objectives, prepare and review all correspondence and reports, maintain the publications file, and "generally keep the FMO appraised of the current inventory status and other pertinent information concerning fuels transactions" (15:4). This section also serves as the materiel control function for the branch. In this capacity, it is

responsible for monitoring all on-hand equipment levels and for ordering supplies necessary to support the branch. Personnel assigned to this section may also be utilized to service aircraft during contingencies (5:35-37; 15:4-5; 10).

The Quality Control and Inspection section (QC&I) is one of the most vital functions of any Fuels Management Branch. This section is mainly responsible for performing the following two tasks:

> First, they control product quality to ensure all fuel is kept clean, dry and on-specification from time of receipt to time of issue. Second, they inspect each Fuels sections, ensuring the entire fuels operation performs safely, efficiently and according to directives (15:6).

This includes regular sampling of all refueling equipment and facilities, but also all fuel storage tanks on base. The main reference guide for the base Fuels Lab, a section of QC&I, is TO 42B-1-1, Quality Control of Fuels and Lubricants. The QC&I inspector serves as the "eyes and ears" of the FMO and, as such, is responsible for pointing out problems in any aspect of the fuels operation. Some of the main areas on which the inspector must concentrate are safety, operational performance and compliance with applicable regulations and manuals, fire prevention, and effective quality control procedures (5:38-46; 15:6-7).

The final section in a typical Base Fuels Management Office, Training and Mobility, is usually the smallest

section, with only one NCO (and possibly an assistant) assigned. The Training NCO is responsible for ensuring that all Upgrade Training (UGT) and Recurring Qualification Training is scheduled, performed and documented. This NCO is also responsible for the development and implementation of the branch Rotational Training Program. In addition, this person will also usually serve as the Mobility Monitor. In this capacity, he is responsible for ensuring that personnel in the branch assigned to mobility positions have all the required documents, equipment, and immunizations necessary to perform these duties. At larger bases with a significant mobility commitment, this duty may be assigned to a separate Fuels Mobility section (5:28-31,47-53; 15:7).

Daily Operations

Many of the operations and duties performed on a daily basis are labor intensive and rely on paperwork and accounting forms and procedures that "have not significantly changed, in substance or function, over the last eighteen years" (11:1-2). In fact, the main idea behind PETROL RAM is to automate many of these procedures and to "provide automated data for management of fuels resources" (17:3). This section will briefly look at those areas and operations which will be most affected by the proposed enhancements, concentrating mainly on the

aspects of the operation which promote the greatest chance of error and improper activities (14:all).

Fuels Distribution, at a typical base, "provides a 24-hour per day, 7-day per week capability to deliver and dispense bulk fuels, oils, demineralized water, and water-alcohol solutions" (5:63). One of the main duties of personnel assigned to this section is, obviously, to perform servicing operations on aircraft with jet fuels of various types. To perform these operations, procedures outlined in T.O. 36A12-13-1-131CL-1, Aircraft Servicing and Refilling Procedures for USAF Fuel Servicing Vehicles, are used extensively. Many of these procedures are safety-related, and one of the most important of these is to verify that the proper grade of fuel is being delivered to the aircraft--"servicing aircraft with the wrong fuel could be catastrophic" (6:8). To do this, the refueling unit operator obtains the DD Form 1896, "Jet Fuel Identaplate" from the aircraft crew chief immediately upon arriving at the aircraft. If the tail number found on the DD Form 1896 is found to match the number on the tail of the aircraft, and the fuel grade code on the identaplate is the same as the one in the refueling unit, the operator prepares the unit for the required servicing operation (3:5; 21).

Once the operation is complete, the operator must "complete [the] accounting forms, insure identaplate is

returned to [the] crew chief, and obtain [crew chief's] signature" on the AF Form 1994/1995, "Fuels Issue/Defuel Document (DOD/Non-DOD)" (3:6). This seemingly simple operation is the origin of many of the problems encountered in a typical BFMO. Incomplete and inaccurate entries on the forms, incorrect calculations, and lost or missing forms all contribute to "inefficient processing methods" which detract from the proper accounting for, and issuing of, fuel needed to sustain mission-capable aircraft (3:5-7; 13:4; 14; 21).

Another problem which may develop in a servicing occurs when the aircraft's DD Form 1896 is misplaced. When this occurs, all of the information normally found on this form must be hand- scribed onto the AF Form 1994/1995. Lack of this form also makes verification of the fuel grade more difficult. This occurance only compounds the potential problems associated with an aircraft servicing operation (14; 21; 9).

Fuels Storage is tasked with providing "a 24-hour per day, 7-day per week capability to receive, store, transfer, and inventory bulk petroleum and cryogenics products" (5:70). In addition, personnel assigned to this section are required to perform daily inspections of all facilities under their control, to perform leak tests on all fuel tanks (as required), and to operate the Service Station (5:70-71).

One of the most important, and time consuming, of any of the duties of a typical Storage Section is to inventory, or gauge, all assigned fuel tanks. This procedure, which is usually performed daily, is accomplished in accordance with T.O. 37-1-1, General Operation and Inspection of Installed Storage and Dispensing Systems. At present, all of these gaugings are made using a steel tape measure with a weighted bob on the end, a thermometer, and gauging and conversion charts.

The main problem with the current system of gauging tanks is the reliance on manual calculations and the specification that "two identical readings [are] required to insure an accurate gauge has been accomplished" (8:3-4). A difference of as little as one-eighth of an inch could mean a variance in reported inventories of thousands of gallons, depending on the size of the tank. One of the dangers of this type of accounting is the inclination of some personnel to only take one reading from the tank and enter the result as the correct inventory. Such practices may lead to faulty reporting of inventory levels, as well as mismanagement of Air Force fuel stocks, and cannot be tolerated (14; 21).

Proposed System

As stated earlier, Project PETROL RAM is a concept designed to provide enhanced technology and automated data for the management of fuels resources. There are

currently five active PETROL RAM initiatives grouped together under the "umbrella" of the Fuels Automated Management System (FAMS), which is formally defined as:

> An information management system [designed] to improve the functions vital to aircraft/vehicle servicing, and the automated operations of fuel storage and dispensing systems (13:5).

These five initiatives are Automated Data Collection/Fuels Dispensing System (ADC/FDS), Automated Fuels Service Station (AFSS), Automated Tank Gauging (ATG), PETROL RAM PC, and PETROL RAM Software.

The Automated Data Collection/Fuels Dispensing System is a system in which technology currently available in civilian industry is used to automate issues of fuel to aircraft. The system works like this:

First, each aircraft is equipped with an encoded identification module (EIM), which is basically a microchip containing all pertinent aircraft identification data such as type of fuel required, tail number, billing address, and all other information required for billing purposes. Upon arrival at the aircraft, the refueling unit operator will use a hand-held microchip reader, called a portable data transfer terminal (PDTT), to gather this information. For an illustration of the EIM and PDTT, please refer to Figure 3 in the Appendix. The PDTT will then be used to load this data into a processor, or portable computer, located on the refueling unit. If the fuel grade code from the aircraft is the same as the fuel

in the refueling unit, the pumps on the vehicle will be activated and allow fuel to be pumped to the aircraft. Once the issue is completed, the computer will combine the amount of fuel issued to the aircraft with the aircraft identification data and store it internally in a data file. Upon return to the fillstand for more fuel, the files on all issues are downloaded into the computer terminal located at the fillstand. This terminal at the fillstand is tied directly into the rest of the fuels computer network; therefore, it is possible for the data on these transactions to be retrieved immediately by the FMO or Accounting personnel via modem through a computer terminal. The prototype of this system was, at the time of this writing, being tested at Mather AFB, California. Once fully operational, this system has the potential to save 13 billets, or manpower positions, Air Force-wide (14; 16:5; 18:4; 21:4-5).

The Automated Fuels Service Station is designed to utilize state-of-the-art technology to enhance the accountability of all fuel issues at the Base Military Service Station, which is operated by the BFMO. The system is based on the "Vehicle Identiplates" now issued to each vehicle by the transportation function at each base. The vehicle identiplate, a credit card- like instrument, contains all billing information for the vehicle as well as type of fuel required, serial number,

Vehicle Identification Number (VIN), and other pertinent information. Upon arriving at the service station, the vehicle operator will insert the identiplate into the required pump. If the fuel grade listed on the identiplate matches the type of fuel in that pump, the pump will activate and allow the operator to issue fuel. Upon completion of the fueling operation, the operator will turn the pump off and remove the card. All issue information will then be stored in a processor located at the service station. This information can then be retrieved, via modem, by personnel in the Accounting section. This system began operational field testing at Myrtle Beach AFB, South Carolina, in April 1988. A fifteen year contract to maintain and repair the new system is also being investigated. Potential manpower savings from this initiative are approximated to be 61 billets by fiscal year 1989- 90 (14; 16:2; 17:5-6; 20:6).

Automated Tank Gauging is a process by which commercial fuel tank inventory hardware is used to automate the collection of data for fuel inventories, tank water levels, and fuel temperature. The key to this system is that a bulk storage attendant will be able to retrieve any of the above data on any tank in the system, day or night, by simply using a computer terminal and keyboard located in the Fuels Storage section. This information can then be passed on the the FMO or the

accountants at any time via modem. This program is now being managed under the Management Equipment Evaluation Program (MEEP), a program under which a commercial contractor provides the necessary equipment to the government, at no cost, for one year of operational testing. This equipment is currently being tested at Eglin AFB, Florida, MacDill AFB, Florida, Minot AFB, North Dakota, and Mather AFB, California. This initiative has the potential to save 37 billets when fully operational (14; 16:22; 17:7-8; 20:7).

The last two projects, PETROL RAM PC and PETROL RAM Software, can actually be lumped together into one large category--that of Computer System Enhancement. These together provide the capability to integrate the different systems into the Fuels Automated Management System, or FAMS. PETROL RAM PC provides the hardware, in this case personal computers, to each of the operational sections in a BFMO. This includes Accounting and Administration, Management, the Fuels Control Center, Fuels Storage, and the Military Service Station, to name a few. These computers will then be linked, via modems and communication lines, into an integrated system with real-time interface capability. The delivery of these computers to Fuels Management Branches was begun if 1987 and will continue until all bases are fully integrated. However, requirements for networking of the system were

being assessed at the time of this writing. As the name implies, PETROL RAM Software is a complete package of software designed to "interface" all of the PETROL RAM projects and includes a data base. This package became available for worldwide release in February 1988 (17:9-12; 20:8).

Future Enhancements

PETROL RAM is an on-going process. In fact, there are already several operations which are being considered for automation in the near future. While these ideas are only in the planning phase, it is appropriate at this time to mention them and give a brief description of what is envisioned.

Individuals currently involved in PETROL RAM believe that the next logical step to take after the current technology is operational and proven is to automate the capture of all data concerning ground fuels, such as automotive gasoline (MOGAS) and diesel. It is readily apparent that the same technology which is to be used to gauge jet fuel tanks can easily be used on ground product tanks. In addition, the issue of ground fuels to vehicles, equipment, and organizational tanks can be automated using the technology of the ADC/FDS. However, the feasibility of this proposal has not been determined and, frankly, the benefits may not outweigh the costs of the equipment involved (13; 14; 17:13).

Another area identified by interviewees as showing much promise for automation is the Fuels Control Center. At present, it is mandatory that several visual aids be maintained by FCC personnel. These visual aids are status boards onto which information required to effectively manage the operations of the branch, such as a Vehicle and Equipment Status, Product Inventory Status, Personnel Status, emergency telephone numbers, and other information, is posted (5:60-61). Once the entire Fuels network is tied together, many of these items have the potential to be tracked automatically. For instance, as the Automated Tank Gauging updates the inventory levels in the tanks, this information will automatically be passed on to the computer terminal in the FCC. Therefore, if the controller needs to check the current inventory on hand, he will merely call this information up on his terminal. The implementation of this initiative may lead to significant savings of both time and space in the Control Center (13; 14; 17;13).

Another area which is being investigated is that of automating fuel reports to outside agencies in order to enhance their timeliness and accuracy. Currently, there are eighteen different reports which must be submitted to the Defense Fuels Supply Center, major commands, and other Department of Defense agencies (5:79). One of the most critical of these is the Petroleum Damage/Deficiency

Report, or REPOL. This report must is used for "reporting operational status of the fuels management activity during emergency situations" (5:35), and is usually sent out by the base communications function via classified message over secure communication lines. If there were some type of "on-line" capability between the major command (MAJCOM), who receives the report, and the base, the MAJCOM staff would have immediate, first-hand information on the status of all bases in their command. The advantages to having such information are apparent (13; 17:13).

The other major idea being examined at the time of this writing is the automating of the control of all valves in the base pipeline system. In essence, once this system were operational, a "central controller" would be able to open and close any valve in the pipeline from a centrally located control room. Unfortunately, this idea is potentially the most expensive of any discussed to this point. However, the large gains in speed, safety, and accuracy of receipt and transfer operations may make this system feasible and cost-effective in the near future (13; 14; 17:13)

Summary

This literature review has discussed the the general make-up and organizational structure of a typical base-level Fuels Management Branch, mainly concentrating

on the responsibilities and duties required of each section. This was followed by a brief discussion of the daily operations performed by the sections which will be most affected by the advent of the new systems. Next, a description of each of the different subsystems of the Fuels Automated Management System was performed, concentrating mainly on the characteristics and function of each. In the final section, other areas which are being studied for feasibility and possible future inclusion as Project PETROL RAM initiatives were discussed.

III. Handbook Preparation Methodology

The purpose of this thesis was to prepare a handbook which explains the composition, function, and benefits of initiatives developed under Project PETROL RAM. This handbook was designed to be used not only by the Fuels Specialist (AFSC 631XX) at all organizational levels, but also base Resource Managers, Chiefs of Supply, and all other parties interested in the methods used to refuel aircraft in the USAF. To provide the needed depth to this handbook, it was first necessary to provide the reader with a background of how a typical Base Fuels Management Office (BFMO) is organized and what operations are carried out on a daily basis. Then, the components and function of each of the sub- systems of PETROL RAM were explained in detail, and a comparison of the differences between the new and current procedures was made. Next, possible future enhancements were discussed to give the reader insight into additional initiatives which may possibly be implemented in the coming years. Finally, the available data on the proposed system was consolidated, simplified, and condensed into a concise, easy to understand handbook.

Background and Operational Procedures

The first step in gathering information on the organizational structure and daily procedures of a typical

base- level Fuels Management Branch consisted of reviewing the regulations applicable to the management, issue, and control of fuel stocks in the United States Air Force. The key reference for this discussion was AF Regulation 144-1, Fuels Management. Other sources listed in the bibliography were also reviewed for relevant information.

For information on the daily operations and procedures of the branch, the author relied on personal experience and existing operational checklists, as well as various handbooks which are listed in the bibliography.In addition, interviews with Fuels Superintendents at different bases were conducted to determine if, in fact, there are differences in the procedures being used at various locations throughout the Air Force. Depending on local conditions and peculiarities, Fuels Management Officers are allowed to establish their own policies, procedures, and checklists, within established guidelines, in order to ensure the most efficient and intelligent use of available resources (5:23). However, the basic procedures discussed which will be affected by PETROL RAM initiatives are based on standardized operational checklists and technical orders and are, in essence, the same throughout the service. Therefore, the information supplied does not represent any one base in particular, but instead is a "pooling" of the available data which, in

fact, represents the "typical" operational procedures at a "typical" Air Force base located anywhere in the world.

PETROL RAM Initiatives and Future Enhancements

To gather data on the various sub-systems to be implemented under Project PETROL RAM, and to acquire a background into the initiation and development of the PETROL RAM concept itself, it was first necessary to contact the Air Force offices directly involved in the design, approval, monitoring, and development of these initiatives. From these offices, all available data on Project PETROL RAM, its proposed systems, their characteristics, components, and capabilities, and their current status was obtained. This data took the form of anything from point papers and slide presentations, to contractor-supplied drawings and descriptions. While this printed information was lacking in depth, it did provide the basis for further investigation.

To gain a further, in-depth understanding of these systems and their capabilities, it was nwcessary to conduct interviews with various offices involved in the development of the initiatives. Especially useful was the information supplied by HQ USAF/LEYSF and the Standard Systems Center at Maxwell AFB, Alabama. With their assistance, it was possible to fill in the details and gain a thorough understanding of the make-up and function of each of the systems.

The information on future initiatives was harder to come by. Since these were merely concepts, and not yet in either the planning or development phase, they were basically identified by name and simple description only. Again, interviews with personnel at HQ USAF/LEYSF were extensively used and most valuable in obtaining the necessary information.

Handbook Preparation

The handbook itself is simply a basic comparison of the procedures currently being used and the procedures which will be used when these initiatives are implemented. The basic format of the handbook is as follows:

First, a general description of the current procedures being used to perform the various operations, such as the servicing of aircraft, was provided. This description concentrated mainly on the repetitive actions required of the Fuels Specialist. Then, a brief discussion of the potential problems associated with this operation was conducted. Following this, the reader was given an introduction as to what the new system will do and then was provided with a "walk through" of the same operation utilizing the new procedures. After this was completed, a summary of the benefit of the PERTOL RAM initiative was provided, mainly concentrating on the savings of time and paperwork, as well as the decrease in possible errors associated with the new system.

Summary

The initiatives being developed under Project PETROL RAM are going to be introduced at base level very soon. Too many times, the perception is that any new system is filled with "bugs" and will not work as advertised. By failing to provide the persons who will be actually operating the system in the field with any background and explanation of the "better way," one runs the risk of alienating these people and discouraging support for the project among the people that will make it work. Such an approach may lead to problems in implementing the system in question.

The purpose of this handbook, then, was to provide Fuels personnel, as well as the people for whom they work, with the information necessary to invoke their support for these enhancements. By providing the "end users" with a comparison of how the current system works versus what the new system will do, these people will be more prepared to fully appreciate the potential benefits of the proposed system. This approach may potentially lead to a smooth, more efficient transition to the new procedures and thus enhance the support capability of Fuels Branches Air Force-wide.

IV. Conclusions and Recommendations

It is readily apparent that the computer, especially the personal computer, is becoming more and more prevalent in today's environment. Businesses the world over are becoming increasingly dependent on the computer to assist in the daily operation of their enterprize. As the capabilities and sophistication of these machines grow, their uses and applications will also undoubtably increase.

The United States military establishment in general, and the Air Force in particular, have long recognized the advantages of applying computer technology to support its mission. Contrary to this, many of the daily operations of a typical base-level Fuels Management Branch still rely on outmoded methods for issuing, controlling, and accounting for fuel stocks. However, with the advent of Project PETROL RAM and its related initiatives, the Air Force has made a conscious, dedicated effort to bring the Fuels Branch's operations more in line with modern methods and procedures.

Research Summary

The very nature of the job of refueling aircraft and handling volatile materials such as jet fuels means that safety is, and should be, the primary motivator of every

person involved in these operations. However, another prime factor to consider is the enormous cost of both acquiring and issuing these stocks, both in the price of the fuel itself as well as the cost of manpower. It is imperitive that the most efficient and cost effective way of accounting for, maintaining, and handling these stocks be found. With Project PETROL RAM, the USAF has taken a large step in this direction.

The Automated Data Collection/Fuel Dispensing System will greatly enhance the way fuel is issued to aircraft on USAF bases. By eliminating many of the repetitive, time-consuming aspects of the operation, this system will go a long way toward decreasing the time required to perform these refueling and defueling operations. In addition, by automating most of the transaction processing procedures, this system will eliminate many of the errors now being made and thus enhance efforts to account for the fuel stocks.

The Automated Fuel Service Station is another initiative which will enhance accountability of fuels in the Air Force. In addition, it will free personnel from performing a "monitoring" task and thus increase the number of personnel available to perform the branch's primary mission. Finally, the elimination of the paperwork now required to account for the fuel will reduce

the number of accounting personnel required to process daily reports and inventory forms.

Automated Tank Gauging will also increase the productivity of personnel assigned to the BFMO. The elimination of current gauging procedures will ease the workload of Storage personnel and thus greatly improve the utilization of manpower positions at bases throughout the world. In addition, by deleting the requirement for fuels personnel to routinely climb tanks, this system will enhance the safety posture at many locations.

The amount of information available to all levels of the fuels community, up to the Air Staff level, will be greatly improved by the introduction of PETROL RAM PC and PETROL RAM Software. By providing an on-line capability, these initiatives will provide more current status on the base-level fuels operation and, thus, the capability to more effectively control these processes.

Recommendations for Future Study

Due to the nature and timing of this study and the resulting handbook, several areas lend themselves to futher study. These areas and ideas are discussed below.

The first recommendation is that this handbook be updated once all of the proposed systems are operational and installed. Since this handbook was written during the development and test phase of the project, there may be some changes in each system's design which could not be

anticipated at that time. Therefore, to provide the most accurate and useful information possible, any future handbooks must incorporate any changes which may occur.

A second recommendation concerns the surveying of Fuels personnel, especially mid-level and senior NCOs, for their ideas on ways to further automate and streamline the fuels organization. Many of the best ideas come from the people who have to perform the tasks day in and day out--this knowledge should be utilized and could be very informative.

A third recommendation is that a study be done to determine which, if any, of the remaining forms currently required to operate a base Fuels branch can be eliminated. Many of these forms may be redundant and unnecessary, and could possibly be eliminated without being detrimental to daily mission support. By reducing the number of forms used, the ability to track and account for fuel may be enhanced.

The final recommendation for future study is the most complicated and, potentially, the most useful of the four. An investigation into the feasibility of establishing a base-wide computer support network should be performed. By tying in the Fuels network to such organizations as Transportation (Refueling Maintenance section) and the Civil Engineers (Liquid Fuels Maintenance section), information on the status of repairs to refueling

equipment and facilities could be enhanced. An added benefit would be the elimination of work orders currently being used to track this information. Further, Aircraft Maintenance (Maintenance Control) could be brought on-line, thus enhancing the ability to request and control priority refueling and defueling operations. If feasible, such a system could greatly enhance the support capability of any given base.

Summary

The technology involved in the PETROL RAM initiatives is not new. On the contrary, these ideas are currently being used, in one form or another, in civilian industry throughout the world. In fact, the main purpose of these initiatives is to make this technology available and tailor it to Air Force needs. This thesis resulted in a handbook which attempts to make sense of this technology and present it in a way which can be understood and appreciated by personnel of all ranks and levels of experience. By providing "advanced warning" to the people most responsible for ensuring the success or failure of these new initiatives, the transition to the new procedures can only be enhanced. If these systems are accepted and fully utilized, the benefit to the Air Force and the ability to support its mission will be enormous.

Appendix A

HANDBOOK ON PROJECT PETROL RAM:

PROPOSED ENHANCEMENTS TO

BASE-LEVEL FUELS OPERATIONS

Preface

Each year, the United States Air Force uses billions of gallons of petroleum products in support of its mission requirements. Without these products, the Air Force would not be able to perform its primary mission--to fly and fight. This is pretty obvious to most people in the service. However, the people most directly involved in the refueling of aircraft and the handling of the fuel itself, especially the personnel assigned to the Fuels Management Branch, are painfully aware of the fact that there are problems with the way in which these duties are carried out. The procedures now used to issue, control, and account for these products are badly outdated. However, help is on the way.

The purpose of this handbook is to introduce those people concerned with the fuels business to Project PETROL RAM and how it will improve and simplify base-level fuels operations. When completed, the improvements developed by PETROL RAM will not only make the job of the base-level Fuels Officer and 631XX personnel much easier, but will also improve the accountability and control of fuel inventories on base.

This handbook is not a "user's manual" or a detailed description of how the various systems will work. Instead, it is a basic overview of what makes up each of

the systems and what each will do to make it easier to account for fuel issues and receipts. If nothing else, this handbook should provide a preview of what to expect in the fuels business in the coming years. Hopefully, you will find it useful.

Another point which should be made at this time is that the examples used in the book may or may not look exactly like the operation at your base. In putting the book together, I tried to combine all of the different ways of doing the job into a "typical" operation. Don't get hung up on this, since it is there just to show how much the new systems will change the way we run our business.

The dedication of this handbook is threefold. First, obviously, I'd like to dedicate it to my advisor, Mr. Charles Youther, and to my wife, Kelly, for putting up with me during its writing and ensuring that I'd get it done. However, maybe more importantly, I'd also like to dedicate it to CMSgt (Ret.) Claude McFalls, CMSgt (Ret.) Curt Mansfield, SMSgt Charles Conrad, and all the other "old POL troops" with whom I've had the pleasure of working over the last five years. While it's not possible to name them all, the professionalism and dedication of POL personnel around the world are key in ensuring that the Air Force is ready to perform any mission which it may

be given. Finally, I'd especially like to thank SMSgt Willie F. Wilkerson, the FMO at Maxwell AFB, AL, for his technical help in putting this handbook together. Without his help, none of this would have made any sense!

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Chapter One:
What is PETROL RAM?

Introduction

You've all probably heard the saying "do more with less." In the base-level fuels business, or POL (Petroleum, Oils, and Lubricants) as it is better known, this is a way of life. Despite the fact that POL is a "labor intensive" business, it seems that there are never enough trained and qualified personnel available to do what needs to be done. Tie this to the large number of operations which require a "two-person policy," and its easy to see that each base could probably use a lot of additional slots. But, this isn't going to happen, or at least not in the near future. With the present budget cuts and reductions in manpower levels, the chance that more troops will be available is slim. However, some help is on the way.

What Is PETROL RAM?

Back in 1984, an initiative was begun to look at ways to reduce the amount of paperwork being done in the field and to simplify the way we issue and account for fuels in the Air Force. This initiative, named Project PETROL RAM, was started at the Air Staff level and was to investigate all aspects of the base-level POL operation, from receipt

and storage to distrubution, quality control, and accounting to find out if there were any areas which could be automated or "computerized." Out of this came five basic ideas for improving the system. These are :

1. Automated Data Collection/Fuels Dispensing System (ADC/FDS)
2. Automated Fuels Service Station (AFSS)
3. Automated Tank Gauging (ATG)
4. PETROL RAM PC
5. PETROL RAM Software

For the purpose of this handbook, these last two will be grouped together under the heading of Computer System Enhancements. Each of the five are, simply, a system in which computers are used to make it easier for the troops in the field to carry out the daily operations required in a typical Fuels Management Branch.

By the way, you may have heard the term FAMS (Fuels Automated Management System) being used whenever the new systems were discussed. Don't be confused--they basically mean the same thing. FAMS is the "information system" which will tie these separate ideas together into one big system. In other words, think of PETROL RAM as an on-going study which is looking at all areas which can be improved in POL operations, while the five above can be broken out and grouped under FAMS. However, for the most part, PETROL RAM and FAMS refer to the same thing.

What Is This Book For?

There are basically three reasons for writing this handbook. First, to explain in simple terms what each of these sub-systems will do and how each will make it easier to do the daily POL operations. Second, to give you a rough idea of what is coming. Third, and probably most importantly, to serve as "rumor control" for these new systems. This handbook is not to be confused with a technical guide to what the system will do, but instead is written in such a manner that everyone can understand and appreciate the advantages of the new system and how it will help POL troops perform their duties.

Chapter Two:

Automated Data Collection/Fuel Dispensing System

Introduction

The main job of a typical Fuels Branch is to make sure that the aircraft get enough clean, dry fuel to accomplish the mission of the base. The people who are mainly responsible for getting the fuel to the planes are the ones in the Distribution Section, both Mobile and Hydrants. And their job is not easy. Because of the dangers involved in handling these petroleum products, the first concern of any POL troop is safety--and rightly so. Due to this, there are many safety procedures and checklists which the POL operator must follow during any aircraft servicing. However, this is not all they have to worry about. As with anything in the Air Force, the paperwork must also be considered! This is where the problem comes in. It's a safe bet that, while almost every servicing is done safely and according to regulations, there are daily problems with the AF Forms 1994 and 1995, "Fuels Issue/Defuel Document," at most bases. Missing information, incorrect meter readings, and lost forms are just a few of the problems which give both supervisors and accountants fits.

No one is going to do away with the safety procedures--they work and are needed to make sure we don't

lose people or equipment. Instead, why don't we make it easier to do the paperwork and at the same time make it easier to account for the fuel? That is exactly what the Automated Data Collection/Fuel Dispensing System is designed to do. To explain how, we'll first look at how the job is done now and then see how it will be done under the ADC/FDS.

What Do We Do Now?

Let's take a look at a typical servicing operation using a refueling vehicle to see what is involved. Let's start at the time the refueling vehicle, or unit, gets to the aircraft. After stopping at least 25 feet from the aircraft, the operator "visually inspects" the area to make sure it is safe to bring the vehicle up to the aircraft. Then, under the direction of the crew chief, the POL operator will position the vehicle for servicing. Once in the proper position, the operator will set the parking brake, transmission, and power take-off interlock system as required, shut off the radio, and chock the unit. Then, the unit is grounded and bonded to the aircraft. At this time, the operator will take the aircraft identaplate, usually a DD Form 1896, "Jet Fuel Identaplate," from the crew chief, make sure it is the right card for that plane, and verify that the unit has the proper fuel grade for the aircraft. The operator then prepares the vehicle for the servicing operation and pulls

the hoses out to the aircraft. Once the crew chief has secured the nozzle to the aircraft, the servicing can begin. During the servicing, the operator must closely monitor the control panel of the unit to make sure everything works as it is supposed to.

Once the operation is finished, the operator will insert the aircraft identaplate into an imprinter, place an AF Form 1994 on top of the card, and move the handle of the imprinter back and forth over the form. This is done to copy all of the billing information onto the 1994. Once this is done, the operator must then enter a lot of information by hand. Things such as transaction identifiation code (TRIC), seriel number of the form, beginning and ending meter readings, and other data such as date, organization code, and system designator must be entered in the correct blocks on the form. After all of this is finished, the operator will get the crew chief to sign for the fuel, give him a copy of the 1994, and return the card to him. The hoses are then put away and the operator can go to the next servicing.

Once the truck is empty, the operator will go to the fillstand to refill the unit. At this time, the operator has to add up all of the issues (from the 1994s) and enter the total issued from the unit onto an AF Form 1232, "Bulk Fuel Issue/Defuel Summary." All of the 1994s are placed inside of this "form" (it's just like a plain envelope

with writing on the front) and the 1232 is turned in to the fillstand attendant. A new 1232 is given to the operator, and the whole thing begins again.

So What's The Problem?

All of this looks pretty easy, doesn't it? But, you've got to remember that a lot of the information that is needed by the Accountants has to be entered by hand on the forms. On top of this, all of the issues must be added up to get a total for the 1232s. And this doesn't even take into account the times that the aircraft's identaplate is missing. When this happens, the amount of information that must be entered by hand doubles. Any time you have to enter this much information on a form, or have to add and subtract numbers, there is a chance that errors will be made. The best way to keep this from happening, then, is to cut down on the number of entries and calculations that are being made by hand and to make sure that there is no chance of misplacing the aircraft's identaplate. Let's see how.

How Does ADC/FDS Work?

Let's go back to the operation we discussed earlier to see how the ADC/FDS will change the way we perform servicings. The initial safety checks and positioning procedures will be the same under the new system. The changes start with the identaplate-- there won't be one

for the aircraft under the new system. Instead, each aircraft will have an "encoded identification module" (EIM) installed on it (see Figure 1). This EIM (Figure 1) is simply a device which contains all of the information about the aircraft, such as home station, billing address, tail number, fuel grade code, and all of the other information that is needed to account for the fuel. The refueling equipment, including refueling units and hosecarts, will also be different. Each piece of equipment will have a "dedicated processor," or on-board computer, installed on it (Figures 2). This computer will be used to "read" the data from the aircraft, activate the pumping mechanism, and record the information. Here's how it will work.

After the operator pulls the hoses, he will insert a "portable data transfer terminal" (PDTT) into the aircraft's encoded identification module (Figure 3). This PDTT, which will be about the size of a hand-held calculator (Figure 3), will then read the EIM and store all billing information we talked about earlier. The operator will then go back to the unit and plug the PDTT into the computer on the vehicle (Figure 4). He will, at this time, also type in the appropriate transaction identification code (TRIC), such as 1RF for a refueling, on the computer keyboard (Figure 4) and press the start button. If the fuel grade codes match up, the computer

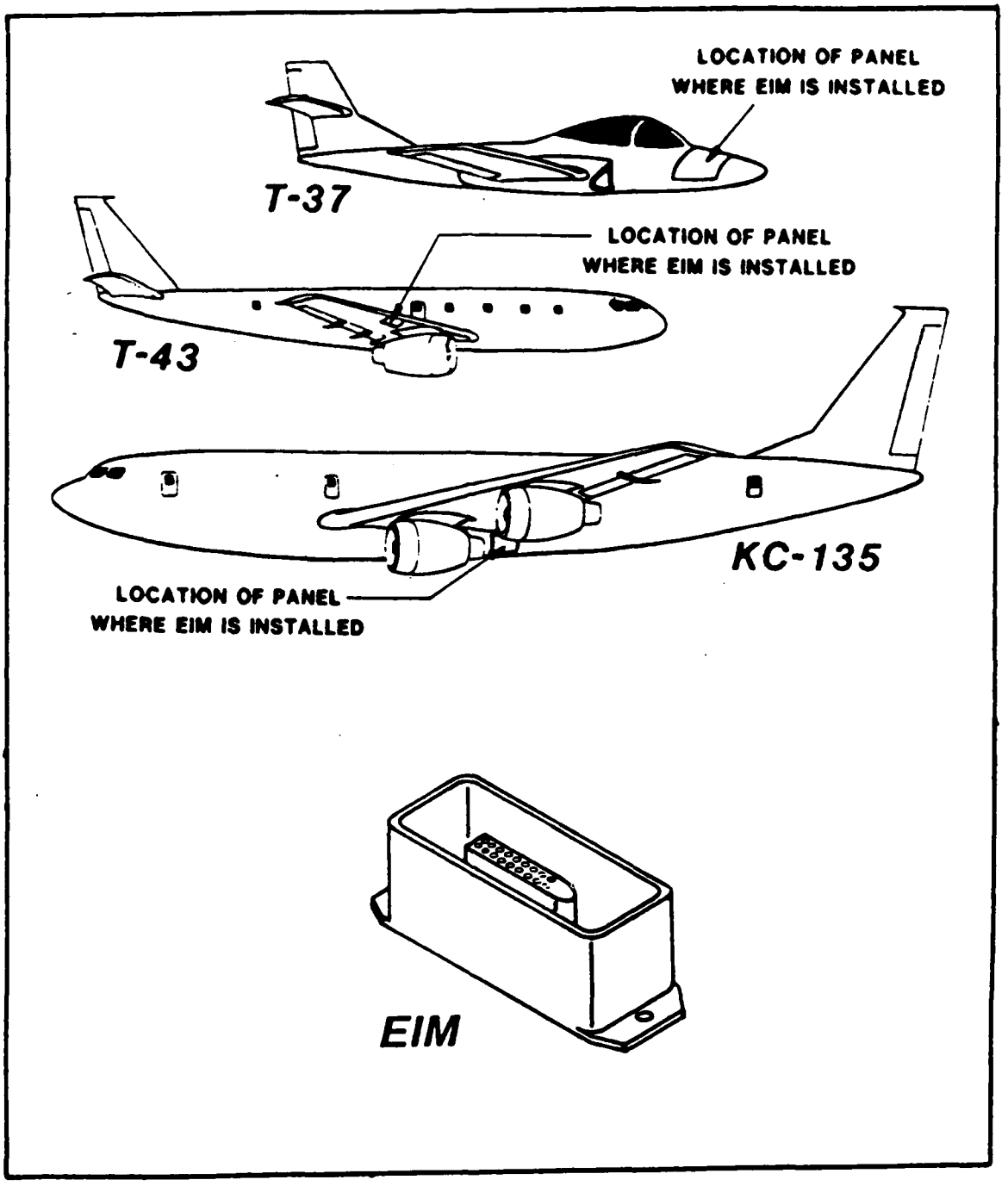

Figure 1. Eim and Location on Aircraft

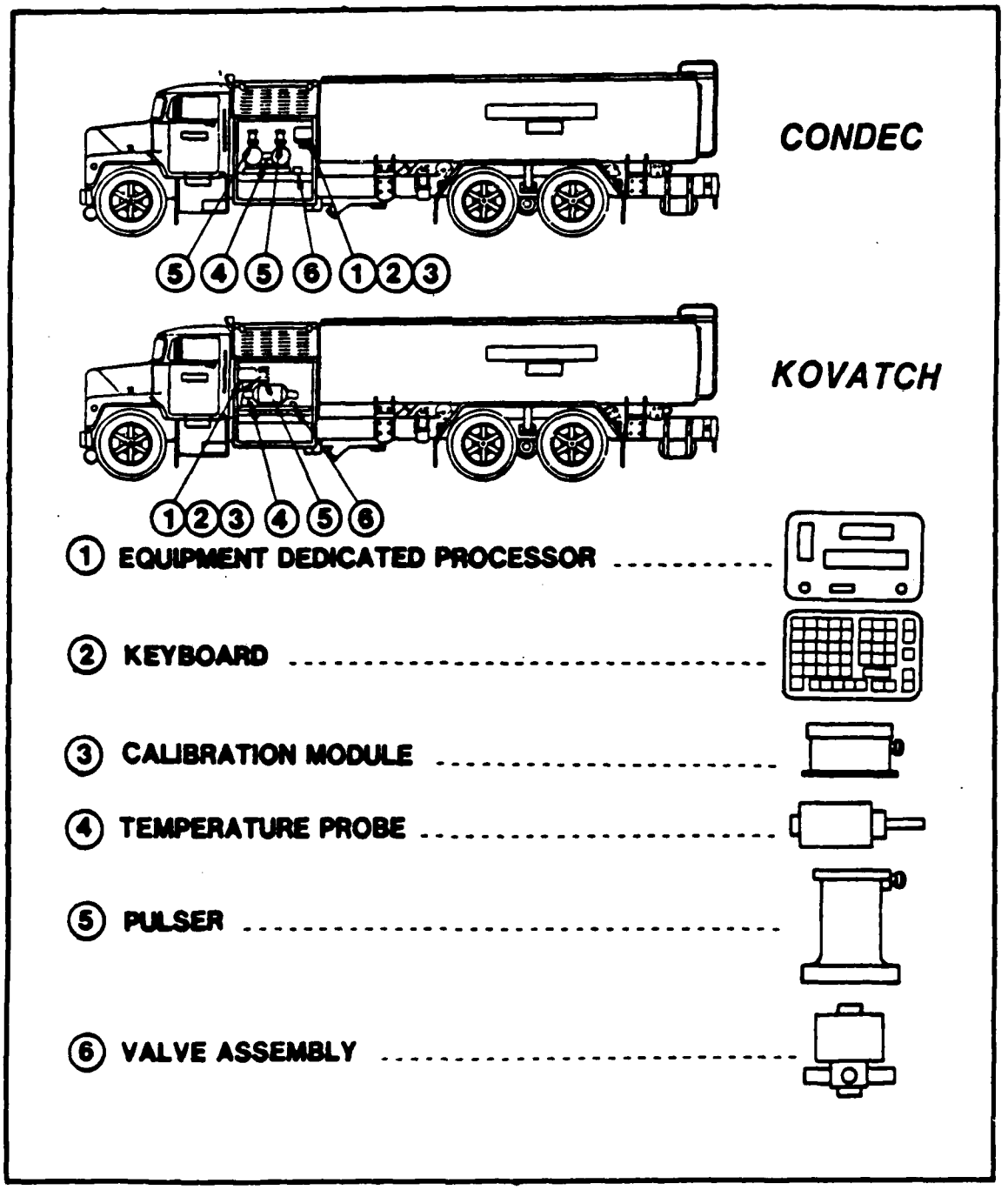

Figure 2. Location of Equipment on Refueling Units

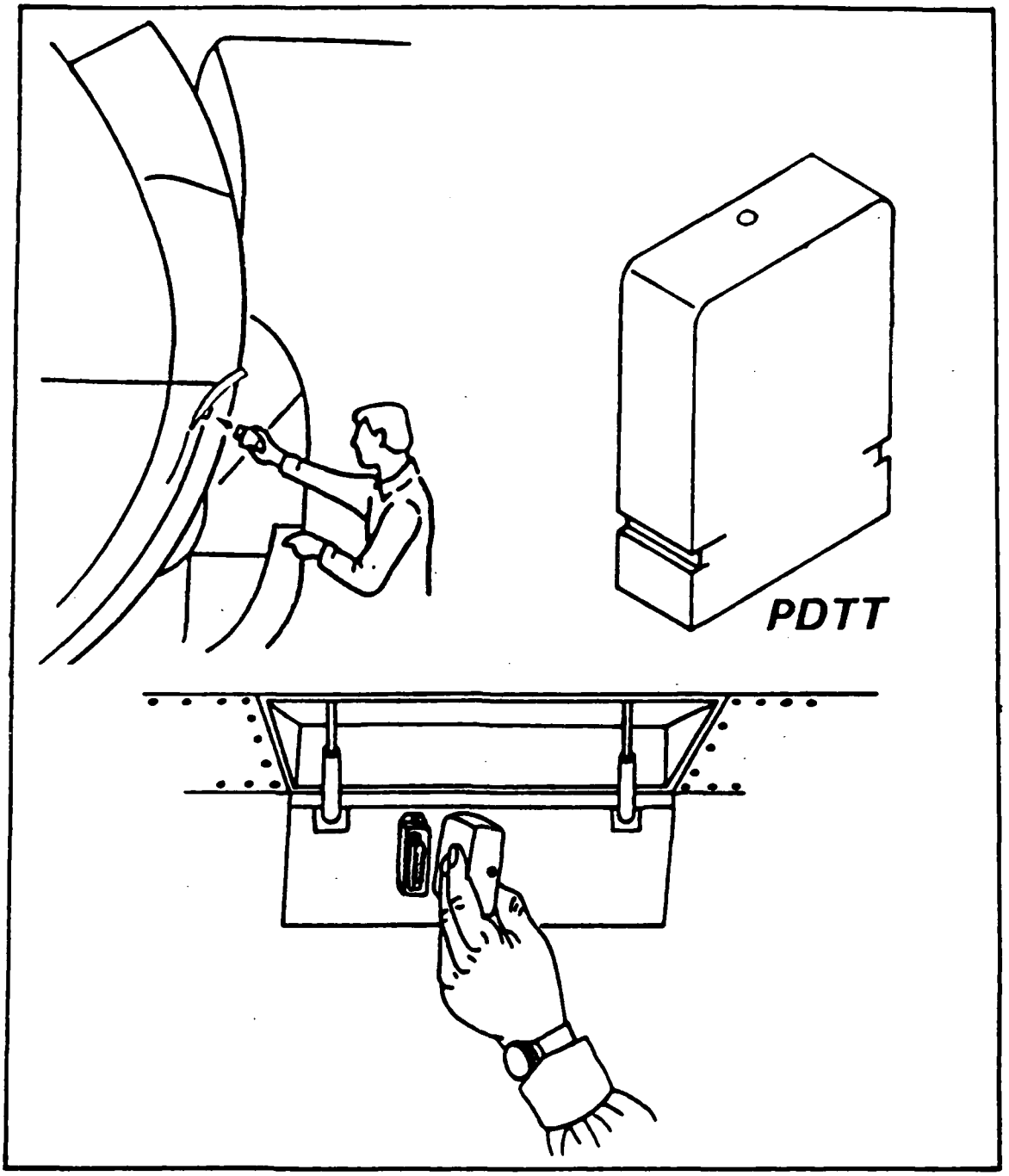

Figure 3. Reading EIM with PDTT

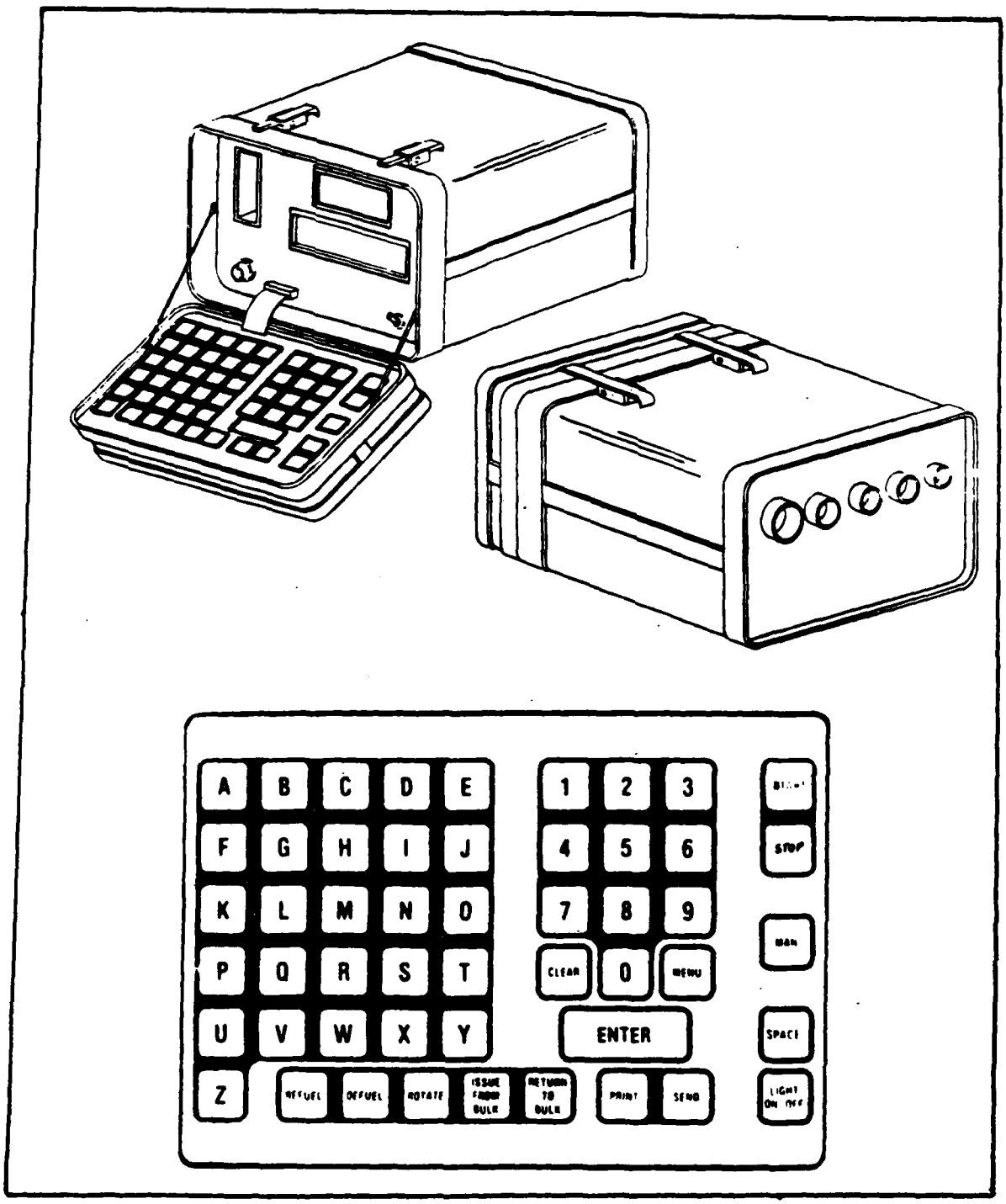

Figure 4. Equipment Dedicated Processor and Keyboard

will open the tank vent valve and get ready to pump. After this, normal procedures are used to refuel the aircraft. Once the operation is finished, the operator turns the pump off, and all the needed data, such as gallons issued, is automatically recorded and "filed" in the computer. A "receipt" will then be printed out by the computer. This receipt will be a simple, easy to read form which will contain all information about the transaction, such as amount and type of fuel issued, date, the unit which issued the fuel, and other information needed by the crew chief for his records. This receipt will then be given to the crew chief. Now all the operator has to do is roll up the hoses and leave!

Downloading The Data

Whenever the unit is empty, the operator will return to the fillstand. A computer will also be installed there. The operator simply uses the same PDTT to transfer information from the unit to this computer, which is linked by phone lines to the rest of the POL computer system (Figure 5). All the accountants have to do is "call up" the information on their computer terminal to find out how much fuel has been issued. Also, all fuel issues from the fillstand to the units will be recorded. As far as hosecarts are concerned, there will be another central terminal where they can be downloaded. This terminal will also be tied into the POL system.

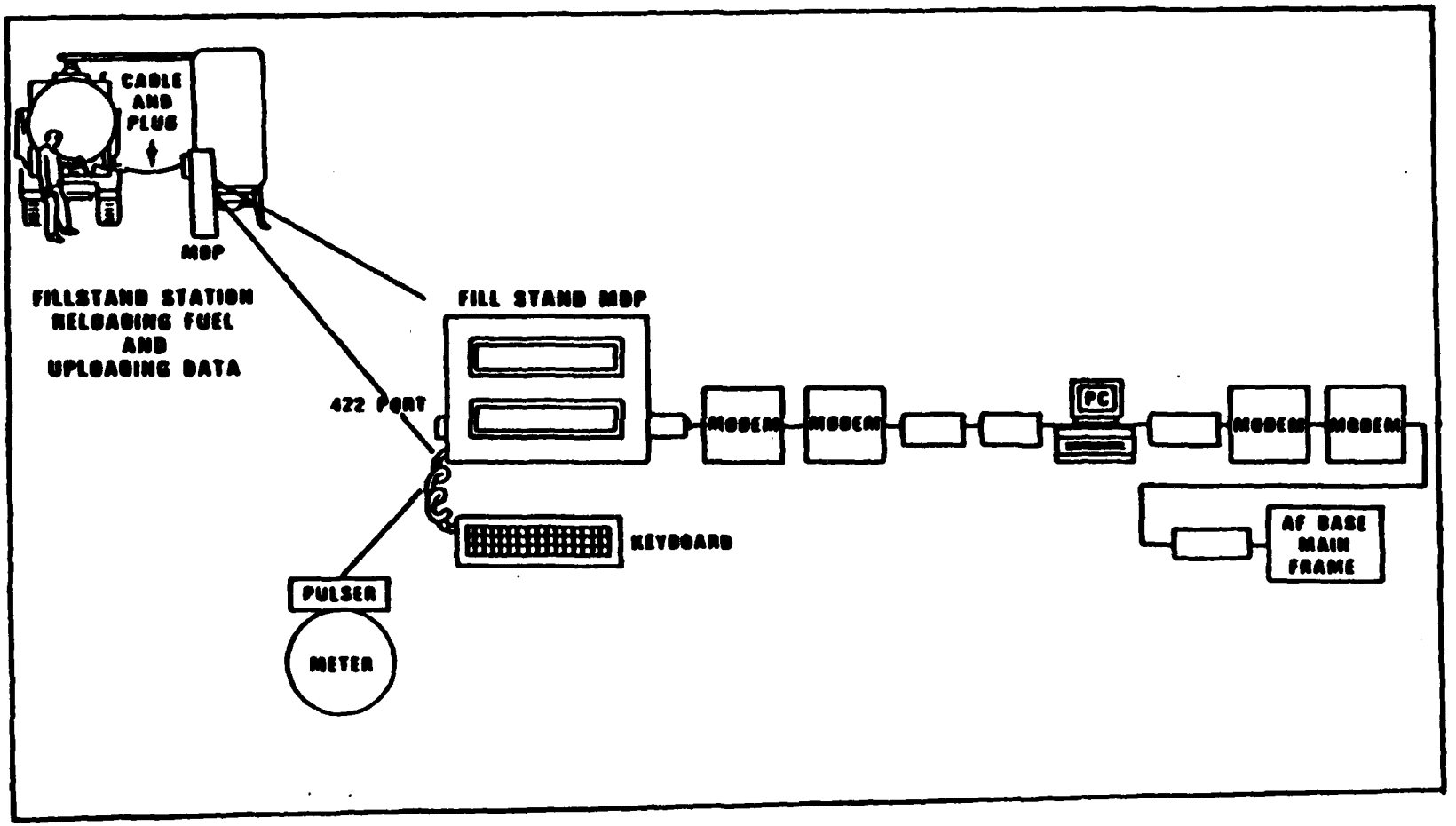

Figure 5. Downloading the Data

What's the Catch?

As with anything that sounds this good, you're probably wondering what the "catch" is. There is one small one--what happens if the aircraft is not equipped with an encoded identification module? Well, the answer is easy--it is done manually. However, it won't be done as it is now. Instead, as was mentioned before, each on board computer will have a keyboard attached to it. If the aircraft does not have an EIM, all the operator has to do is type in the necessary information. But, don't worry too much about this. The Army and the Navy are already looking into this project and seem to like the idea. Before long, every U.S. military aircraft will probably be equipped with an EIM.

Summary

As you can see, this new system will make the job of the POL troop in the field a lot easier. No more lost forms. No more addition errors. No more bad meter readings. Instead, the system will just about get rid of the paperwork now required to track fuel issues. And don't forget about the people in Accounting. This system make their jobs much easier also. In fact, when this system becomes operational, it will free up more "bodies" to perform the basic operations of any BFMO--like getting the fuel into the planes.

Chapter Three:
Automated Fuels Service Station

Introduction

Of all of the duties required in a typical Fuels Management Branch, the one which is probably last on anyone's list of positions to fill is attendant of the Base Military Service Station. This station must be manned during normal operating hours and, in most cases, there must be a standby operator "after hours." This person has to be available to open the station on an "as needed" basis. When this POL attendant is on duty, there is usually very little, if anything, for them to do. Waiting for a "customer" can be very boring, and there's only so much cleaning up you can do. With the coming of the Automated Fuels Service Station (AFS3), however, this should change a great deal. Let's take a look at what goes on now at a typical service station and then at what will happen when the AFSS is operational at all of the bases.

How Does The Station Work Now?

Now, as stated before, the service station attendant, or operator, has very little to do while waiting for a customer to arrive. At the beginning of each day, he must gauge the tanks to find out how much fuel is on hand (this

is called the "beginning inventory"), "stick" each tank for water, and check out the systems to make sure everything is working as it should. Also, he must gauge the tanks at the end of the day and also before and after each receipt. However, other than these minor duties, he is waiting. Once a vehicle arrives at the station his "job" really starts. After taking the "Vehicle Identaplate," or credit card, from the driver, the POL attendant will verify that the driver has the right credit card for the vehicle he is driving and that he is at the correct pump--in other words, he must make sure that the vehicle operator is putting the right type of fuel into the vehicle. The attendant will then either turn on the pump himself or tell the driver/operator to start pumping, depending on local operating instructions (OIs). While the driver is pumping the fuel, the attendant will get the paperwork ready. This is done by running an AF Form 1994 over the identaplate on an imprinter. This is done just like it's done at the local gas station. This "credit card" has all of the billing information on it that is needed by the Accounting section, especially the Vehicle Identification Number (VIN). When the driver is finished putting fuel into the vehicle, the pump is turned off and the attendant writes the amount of fuel received, in gallons, on the 1994. The driver then must sign the 1994 to show that he has received the fuel, and he is given a

copy of the transaction. The attendant then resets the pump and waits for the next vehicle.

At the end of the day, the POL attendant will add up all of the issues from the AF Forms 1994 by hand and will enter this total on an AF Form 1232. He will then regauge the tanks to get an "ending inventory." This ending inventory will show how much fuel is left in the tanks. By subtracting the ending inventory from the beginning inventory, the attendant can tell how much fuel was taken from the tanks during the day. This amount should be equal to the amount of issues entered on the 1232. If the figures don't "match up" and are not within allowable limits (2% of the total), an explanation of the reasons for the difference must be made. Since all of the calculations and tank gaugings are done by hand, it's easy to see that it is very possible that errors will occur.

How Will The AFSS Work?

Based on the above, it is a good bet that this POL troop could be put to better use doing other tasks and that there must be a better and easier way to account for this fuel. There is-- the Automated Fuels Service Station (Figure 6). Let's take a look at how it will work and what it will do for the Fuels Branch.

The first thing you'll notice about the AFSS is that there is no POL troop required to run the station. Instead, everything is done automatically. Here's how it

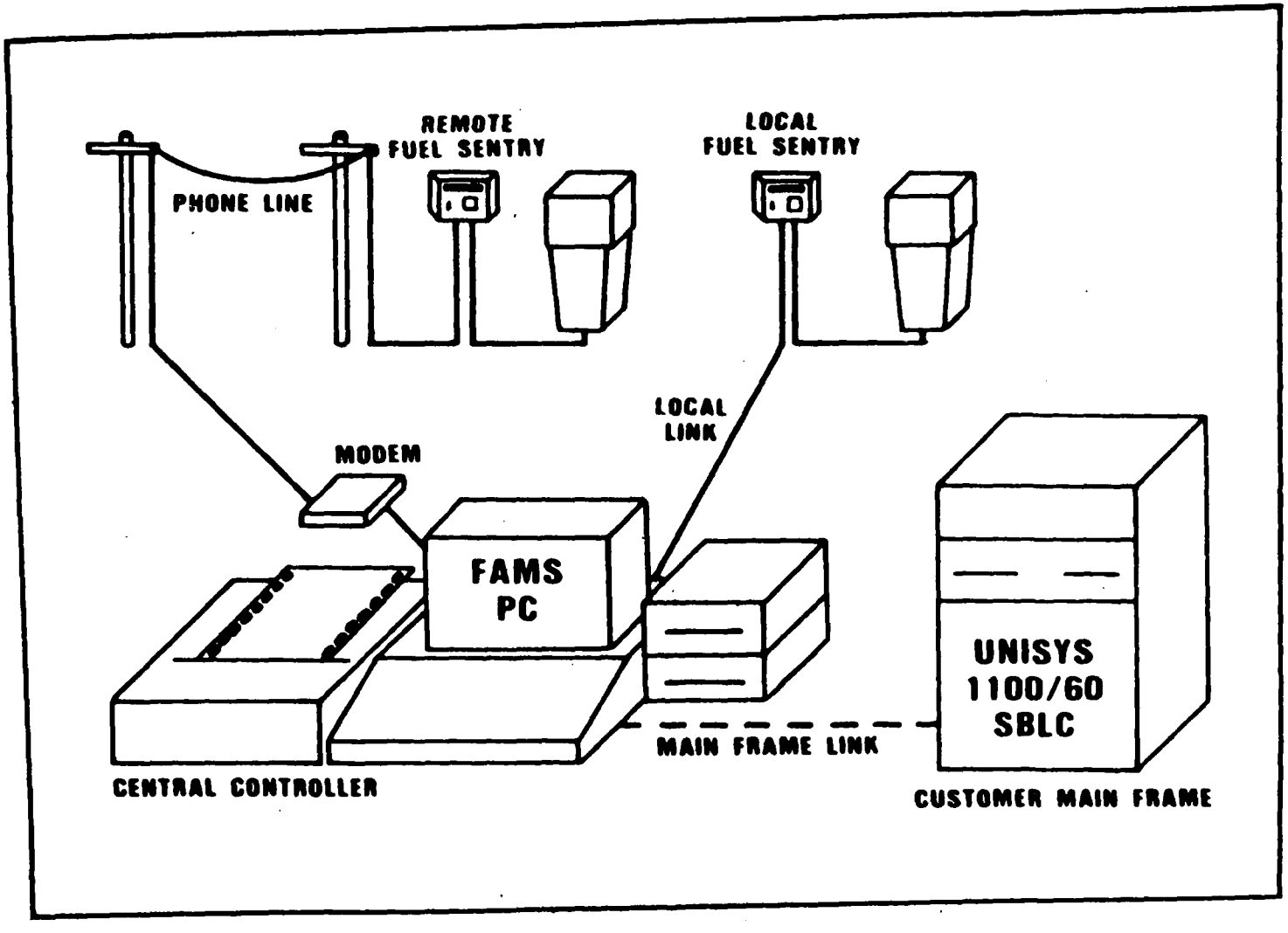

Figure 6. Automated Fuels Service Station

will work. When a vehicle gets to the service station, the driver will pull up to the proper pump. He will then put his identaplate into an "activation device" located at the station. This activation device is basically a remote computer which will "read" the card. Since the card has a letter on it saying what type of fuel the vehicle takes, the computer will know which pump to activate. In other words, if there is a "D" (diesel) on the card, the computer will turn on the power to a diesel pump. The operator will then be able to pump fuel. Once he has finished filling the vehicle, the operator will turn the pump off and remove his card. The driver then leaves the station without having to sign for the fuel or maintain any paperwork. At the same time, all information on the transaction, such as the vehicle identification number, amount of gallons issued, and the type of fuel issued will be automatically stored in a computer microprocessor located at the service station.

How Do we Get the Information?

To get the data on issues, inventory level, and other needed information, all the people in Accounting will have to do is to "call up" the data on a computer terminal located in their office. This will be done at least once a day, at the close of business, but can be done whenever information is needed. Also, since the computer at the service station will be connected to all of the computers

in the Fuels Branch, the people down in Storage, or the Control Center, or the Superintendent, or anybody else with access to the computer will be able to find out how much fuel is left in each tank at any time during the day. All of this can be done without ever leaving the office.

Summary

As you can see, the Automated Fuels Service Station will get rid of one of the most boring jobs in any Fuels Branch. Not only will this system free up a person to help with other duties, but it will also get rid of all of the forms being used at the station. Also, it will keep POL troops from having to manually add all of the issues for the day, will get rid of the "standby" person for after-hours support, and will make it much easier to find out the status of the tanks. In other words, this is going to be a great system!

Chapter Four:
Automated Tank Gauging

Introduction

From what we've talked about up to this point, it looks as if things will be a lot easier for the troops in Distribution. But, what about the guys in Storage? So far, the only help they will get is that they won't have to put somebody at the Service Station. That is probably the easiest part of their job, since gauging tanks and receiving fuel are the things which take up the most time. And everybody knows that climbing tanks can be a real pain. Wouldn't it be nice if there was some way to make it easier to get fuel inventories, temperatures, and water levels which are needed every day, and to perform required leak tests? Well, there is one being developed--it's called Automated Tank Gauging (ATG), and it is probably the most time-saving idea to come out of PETROL RAM.

Current Storage Procedures

One of the most time-consuming jobs of Storage personnel is gauging, or "sticking," tanks. This operation, which is usually done every day on each active tank in the system, must follow strict procedures to make sure that the amount of fuel in the tanks is correctly

recorded. Let's take a look at these procedures to find out exactly how this is done.

When gauging tanks, Storage personnel use two basic pieces of equipment--a weighted-bob tape measure and a thermometer. Before lowering the tape measure into the tank, the Storage troop will apply a water-finding paste to the bottom three inches (3") of the tape. He will also put on a coat of fuel-finding paste at a point three inches (3") above and three inches (3") below the estimated, or expected, level of the fuel in the tank. The tape will then be lowered to the bottom of the tank and then rewound. The paste which was put on before will change color to show how much fuel and water are in the tank. This will show up on the tape measure as feet and inches of fuel in the tank. This procedure must be done again until two identical measurements are achieved. This is done to make sure that an accurate gauge has been performed. The next step is to take this reading and compare it to the "gauging chart" for that tank. This chart, which is different for each tank, will indicate how much fuel is in the tank based on the measurement--in other words, a certain measurement in feet and inches equals to a certain number of gallons. This is an "unconverted," or rough, measurement of the amount of fuel in the tank. For standardization purposes, this amount must then be converted to it's equivalent amount of fuel

at 60 degrees Fahrenheit (F). This is where the thermometer comes in--the temperature of the fuel in the tank must now be measured. To do this, the Storage troop attaches the thermometer to a steel tape and lowers it to about one-half the depth of the fuel in the tank. The thermometer is left there for at least five minutes. The thermometer is then removed from the tank and the temperature is recorded. A conversion chart is then used to get a "conversion factor" for that temperature. In other words, this conversion chart will give a factor (such as 1.2, .8, etc., depending on the temperature of the fuel) which must be used to convert the amount of fuel in the tank to the needed quantity at 60 degrees F. This "rough" measurement, which was recorded earlier, is now multiplied by the factor from the conversion chart. This gives an accurate, or "converted," amount of fuel in the tank. This is the "official" inventory for that tank and is recorded on the AF Form 1235, "Physical Inventory." Water readings, or levels, are also written onto this form.

Another big duty of the Storage section is to receive fuel, either by pipeline, tank car, tank truck, or ship. Before each receipt, Storage personnel must gauge the tank that the fuel is going into to find out how much fuel is in the tank. This is done just as discussed earlier. Once the fuel is received, the tank must be gauged again

to find out how much fuel was received. Again, this quantity must be converted to the corresponding quantity at 60 degree F to get a proper reading. All of the procedures are the same, and this must be done before each receipt.

The other main duty of the Storage section is to perform annual leak tests on all of the tanks in the system. To do this, the tank is gauged (using the proper procedures outlined above) and then is isolated, or locked up, for 48 hours, or two days. The tank is then regauged and the quantity is converted to the corresponding quantity at 60 degrees F using the conversion chart. Any decrease in the fuel level of one-fourth of an inch will indicate that there is a leak in the tank. This leak must then by fixed by the Liquid Fuels Maintenance (LFM) section of the Base Civil Engineering Squadron. This section has overall responsibility for making sure all POL pipelines and systems are operational.

What Will ATG Do?

As you can tell by reading the above, there are a lot of manual calculations which must be done by Storage personnel to get accurate fuel inventories. Also, the procedures which are used open the door for many errors to be made--the more steps you must follow, the more chance for "human error" to occur. But, the Automated Tank Gauging (ATG) system, as shown in Figure 7, should solve

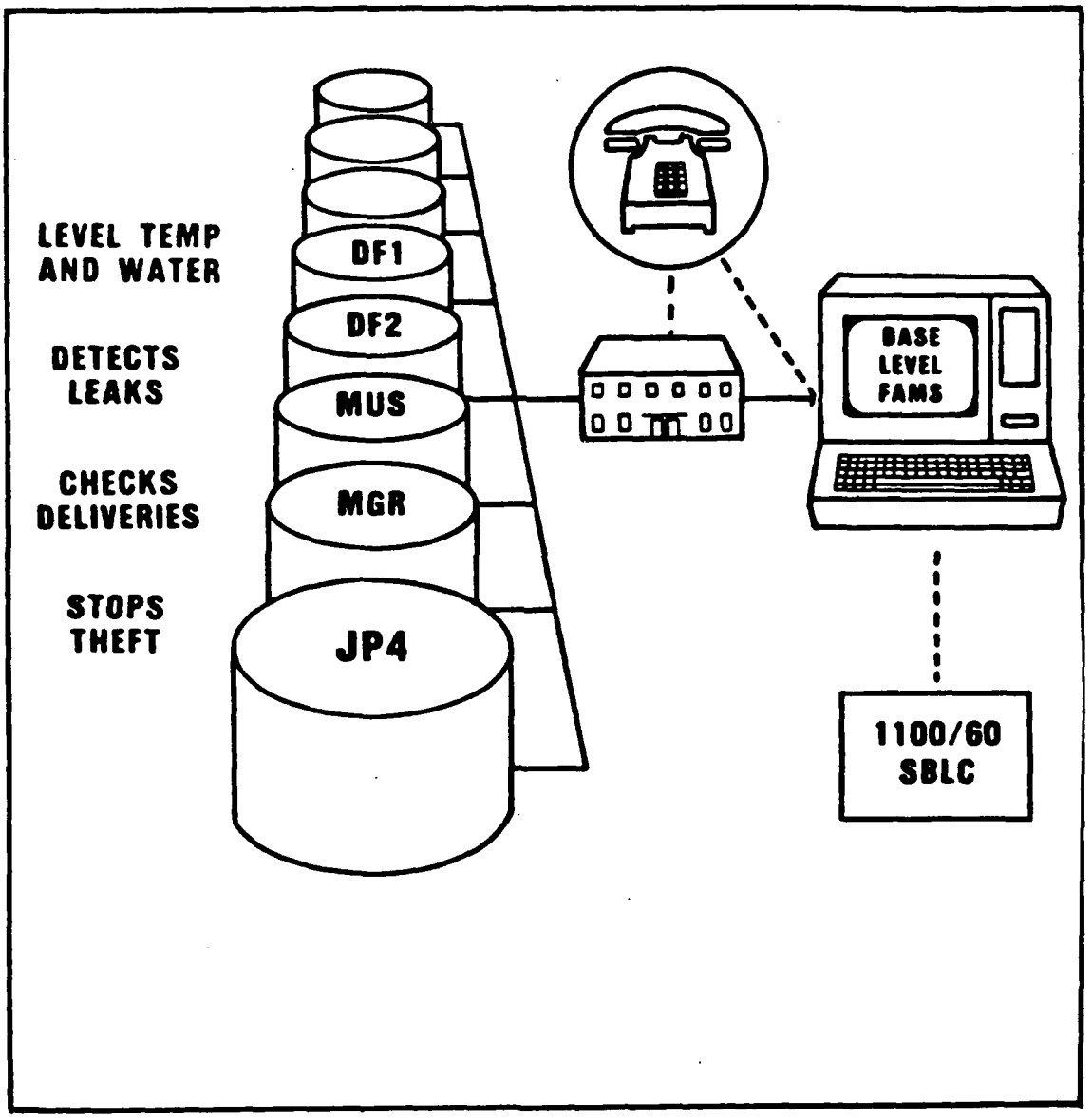

Figure 7. Automated Tank Gauging

these problems and keep the manual work to a minimum. Let's see how.

As the name says, there will be no more manual gauging of tanks when ATG becomes operational--the system will do it automatically. Each tank will be equipped with sensors to measure fuel level, water level, and temperature of the fuel in the tank. These will act a lot like the sensor you have now in the gas tank of your car, except they will be tied into a central processor, or computer, located in the Bulk Storage office. Just by getting into the computer and "calling up" each tank, you will be able to find out the amount of fuel and water in each tank, all converted to the standard quantity at 60 degrees F.

How Much Easier Will ATG Be?

By looking at the Storage operations we talked about earlier, it is really easy to see how much this system will help the Storage troops. As far as tank gauging goes, won't it be a lot easier to sit down at a computer terminal and call up all of the tanks to find out fuel levels instead of having to go out and stick each one? You bet it will--in five minutes you can get the same information that it used to take maybe a couple of hours to get. And, no more manual conversion to find out the required quantity at 60 degrees; the computer does it

automatically. What about receipts? This is even easier. Instead of having to gauge the tank before, you simply call up the tank to make sure there is sufficient ullage, or enough room for the fuel, in the tank and record this figure. After you have finished the receipt, all you have to do is check the level in the tank again. Since you know the amount of fuel you had in the tank before the receipt, and you now have the level after the receipt, it is very easy to figure out how much fuel you just received. And leak tests will be the easiest of all--the sensors in the tank will basically do it for you. All you have to do is isolate the tank--the sensors will tell you if the level has dropped more than one-fourth of an inch. What could be simpler?

So, how does the Accounting section get this information? As we mentioned earlier, the sensors will be tied into a computer located in the Bulk Storage office. This computer is tied in, by a phone line, to the computer in Accounting. All the accountants have to do is call up the information on each tank on their computer! This will give them all of the information they need for their daily reports, and will keep the Storage guys from having to bring this information over to them every morning. This should save a lot of time and give the Accounting people more accurate, up-to-the-minute data.

Summary

Just think of the advantages of this new system. No more climbing tanks every day to get inventories. No more AF Form 1235. No more fatigues covered with paste and fuel. And, most importantly, no more troops on top of the tanks. All of these improvements will make the job of the people in Storage easier, less complicated, and a lot safer. Based on the ease of operation and the amount of time saved, Automated Tank Gauging is probably the best and most usefull idea to come out of PETROL RAM up to now. Without question, you'll be happy with it once you've had the chance to see it operate.

Chapter Five:
Computer System Enhancements

Introduction

So far, we have talked about all of the systems now being tested which will make it easier to perform fuels operations at a typical base. As you can see, all of them are based on the idea of "computerizing" the operations which require the most paperwork and, at the same time, making it easier and safer to perform these operations. Since the key word here is "computer," it is pretty obvious that some sort of computer system is needed to run these different systems and to tie them all together. In this chapter, plans are for doing this will be explained.

PETROL RAM PC

The idea behind PETROL RAM PC is to place a small "personal computer" (PC) in each section of a base-level Fuels Management Branch--in other words, there will be a computer in Accounting, Distribution, Storage, the Fuels Control Center, etc. These personal computers will replace the UTS 40 terminals which are now being used by the people in Accounting.

As you may guess, each of these PCs will have "networking capability," which simply means that they can be "tied together" with the others to form a computer

network (Figure 8). This Fuels network will also be tied in with the Supply computer (SBSS), just like the one in Accounting is now. You may have already seen some of these new computers at your base--delivery began in 1987 and is supposed to be finished before October 1988. Once all of these are delivered, the whole system will be tied together to form the Fuels network.

PETROL RAM Software

As mentioned before, all of these personal computers will be tied together into one system. This is where the software comes into the picture. Software is basically the programs which tell the computer what to do. Without this software, the separate computers would have no way of "talking" to each other, and there would be no way to form a network. To solve this, programs have been written and are now available. Once the computers are available, we'll be ready to go!

That is not all the software will do. Other programs have been written that will keep track of personnel and equipment status, training and mobility status, and all Quality Control and Inspection reports. For instance, a program called FAST, or Fuels Automated Sample Tracking, is now available. This program, while it is not technically a part of PETROL RAM or FAMS, will automate, or computerize, many of the records that are now kept by the Lab people. This program will help simplify the

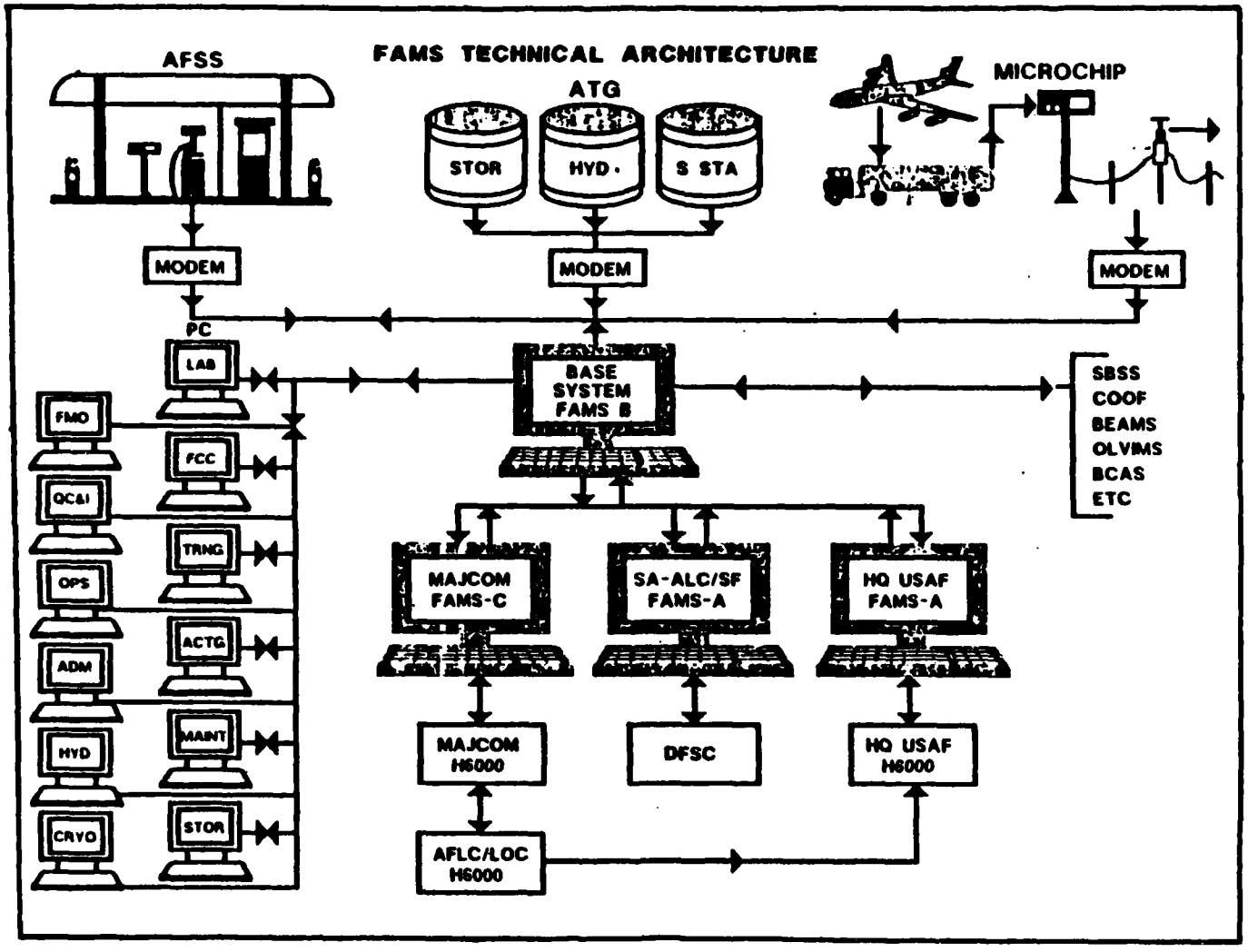

Figure 8. Fuels Automated Management System

scheduling of samples that need to be done, will make it easier to document the results, and will make it easy to "pull up" data on specific pieces of equipment for analysis. In fact, once all of these software programs are perfected, almost all of the paperwork now being maintained in a typical base-lavel Fuels Management Branch will be eliminated. This is something that has been needed for a long time and will be welcomed by everyone in the field.

Summary

It's pretty obvious that computers are the "thing" of the future, and the Base Fuels Management Branch is not going to be left out. When all of the personal computers and software are delivered and installed, the job of the people in the Fuels career field will become a lot easier and less complicated. But, don't think these computers are going to replace the workers--we will always need people to drive the units, operate the equipment, and handle the fuel. And that's what they're paid for!

Chapter Six:
Future Enhancements

Introduction

Earlier, I mentioned that PETROL RAM was an on-going project. Many ideas are now being looked at to see if there are other uses for computers in the field. Areas such as ground fuels, reports to outside agencies, transfer valves, and the Fuels Control Center all are possible subjects for automation. Let's take a look at some of these to find out what is planned for the future.

Ground Products

This is probably one of the more practical of the new ideas. It makes a lot of sense to follow up the improvements in the jet fuel operations with improvements in the ground fuels (automotive gasoline, or MOGAS, and diesel) side of the business. That's why there are plans to use some of the same ideas now being developed under PETROL RAM, especially tied in with ADC/FDS and ATG, for these products. And, it will be simple to do. Once the Automated Tank Gauging system has been perfected, wouldn't it be easy to put the same type of equipment into the ground products tanks? Then, just tie these into the Fuels computer network, and there would be no more need to manually gauge tanks at all!

The only hold-up for this initiative would be, like a lot of other things, money. The management of jet fuel inventories is the top priority now--we use a lot more of it than we do ground products and we spend a lot more for it. But, once these other systems are "on-line," we can move on with increasing the capabilities of every fuels branch in the USAF.

Reporting

Another idea which will save a lot of time and paperwork is to send out all of the reports required by "outside agencies," especially the major commands (MAJCOMs), on the computer. Just think of the time that will be saved by sending out such things as the Petroleum Damage/Deficiency Reports (REPOLs) through the computer lines, instead of by message! Instead of having to wait hours for the needed information, the MAJCOM staffs will have it almost immediately. The advantages of having this capability, as well as the savings in time and paperwork, are pretty obvious!

Automated Fuels Control Center

The Automated Fuels Control Center is another idea which will save a lot of time and space, and get rid of a lot of the hassles that FCC people must go through. Right now, all of the status on people, equipment, vehicles, facilities, etc. are kept in the FCC on large "boards."

These boards must be updated daily and every time there is a change in status. But, as mentioned before, software is now being developed to automate all of this data. Once this is done, just think how easy it will be for the controllers to keep on top of what is going on. Let's say you want to find out if a certain person is qualified to perform a certain servicing operation. All you have to do is type that person's name into the computer, and it will call up all of the information on that individual. Not only will this tell you what operations that person is qualified on, but also when he was last qualified and when he must be recertified. Isn't that a lot easier than searching through the files and trying to read and maintain status boards?

Many other areas are being looked at in the FCC to see if there are more ways of automating this important area of the Fuels operation. But, even if these are the only areas which are improved, the job of the controllers will be a lot easier in the future.

Automated Pipeline Valves

Right now, especially in the older systems, there is a lot of manual work required to transfer, or move, fuel between tanks. Every time you do this, valves must be opened and closed, by hand, to make sure the fuel goes where you want it to go. Wouldn't it be a lot easier if

this could by done "automatically" instead of manually? Well, that's the whole idea behind this initiative.

Just think of the possibilities. When you want to transfer fuel from, let's say, tank "A" to tank "B" for a particular operation, you have to go out and open and close several valves, in most cases. This takes a lot of time to do, and there is always the possibility you may forget one or even open the wrong valve. And we all know how much grief we get for spills! Instead of this, picture the Storage supervisor, or any qualified troop for that matter, sitting at a central control panel. This panel will basically be a diagram of the pipeline system on base with lights to indicate which valves are open and closed. The person operating the panel will be able to look at the diagram, see which valves need to be opened to perform the operation, and then see which valves are currently open. Then, by pushing a few buttons, he will be able to set the system so that the right valves are open and the rest are closed. Now, which way do you think will be easier?

As with the other ideas, this one will need a lot of money-- it's expensive to set up a system like this. But, on the other hand, this is the kind of system that is now used a lot in the "civilian world" at refineries, in oil fields, and in other locations where liquids must be transferred. And it works--which means we don't have to

test out a new system. All we have to do is get the money to buy the needed equipment.

Summary

As you can see, there are a lot of things in the field which can be improved. And, there are Fuels personnel all over the world constantly looking for ways to improve the way we do business. Who knows, maybe you will come up with an idea which will make it easier and simpler to do the job. Keep looking--new ideas and suggestions are always welcome!

Conclusion

The Base Fuels Management Branch will be vastly different from what you are used to seeing now--all because of PETROL RAM and the concepts behind this project. Automated Data Collection/ Fuel Dispensing System, Automated Fuels Service Stations, Automated Tank Gauging, and Computer Enhancements, both PETROL RAM PC and PETROL RAM Software, are all initiatives which will make it easier and safer to get fuel to the "customer" in order to meet the requirements of the Air Force.

Just think of the future benefits of these initiatives. No more redundant, manually prepared paperwork. No more climbing tanks for inventories. No more standing around the service station waiting for something to happen. No more lost reports to headquarters. And, no more manual opening and closing of valves.

But, one thing that will always be needed in any Fuels Branch is you--the Fuels Specialist. Sure, we'll lose a few slots around the world. But, these are usually the slots which aren't filled anyway--the 631XX career field isn't manned 100% now and probably never will be. And, most of the slots which will be lost are the ones which are needed to do the time-consuming duties, such as

filling out paperwork, gauging tanks, etc. These are the jobs which are going to go away, so nobody's job is being taken away. Instead, the people in the field will be able to concentrate on what they do best--put the right amount of the right fuel into the right aircraft in a safe, timely manner. And, when it comes right down to it, that's what POL folks are being paid for!

Attachment 1

TEST LOCATIONS

AUTOMATED DATA COLLECTION/FUEL DISPENSING SYSTEM

323 FTW/LGSF Mather AFB, CA (Gull Corporation)	AVN 828-2316

AUTOMATED FUELS SERVICE STATION

354 TFW/LGSF Myrtle Beach AFB, SC	AVN 748-7881

AUTOMATED TANK GAUGING

3246 SUPS/LGSF Eglin AFB, FL	AVN 872-2444
56 TTW/LGSF MacDill AFB, FL	AVN 968-3462
323 FTW/LGSF Mather AFB, CA	AVN 828-2316
91 SMW/LGSF Minot AFB, ND	AVN 344-3246

Attachment 2

ABBREVIATIONS

Below is a listing of abbreviations and acronyms which were used in this handbook:

ADC/FDS	- Automated Data Collection/Fuel Dispensing System
AFSS	- Automated Fuels Service Station
ATG	- Automated Tank Gauging
BFMO	- Base Fuels Management Office
EIM	- Encoded Identification Module
FAMS	- Fuels Automated Management System
FAST	- Fuels Automated Sample Tracking
FCC	- Fuels Control Center
FMO	- Fuels Management Officer
LFM	- Liquid Fuels Maintenance
MAJCOM	- Major Command (Headquarters)
OI	- Operating Instruction
PC	- Personal Computer
PDTT	- Portable Data Transfer Terminal
PETROL RAM	- Petroleum Resources Automated Management
POL	- Petroleum, Oils, and Lubricants
REPOL	- Petroleum Damage/Deficiency Report
SBSS	- Standard Base Supply System
TRIC	- Transaction Identification Code
VIN	- Vehicle Identification Number

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The purpose of this research was to provide a handbook on Project PETROL RAM and its ideas for enhancing the base-level fuels operations. This handbook is to serve as an introduction and reference guide to the components, characteristics, and capabilities of the proposed initiative.

In preparing this handbook, available information on the structure, operations, and procedures of a typical base Fuels Management Branch was gathered and summarized. Available data on the proposed systems was also gathered, then condensed and simplified. For added depth and understanding, personal interviews with personnel involved in the design and development of this project were conducted.

The research resulted in a handbook which describes, in simplified terminology, the different systems which are being developed under the Project PETROL RAM initiative. During the development of this handbook, indications that PETROL RAM will vastly improve the ability to account for and control vital fuel stocks were found. By decreasing the number of required forms, streamlining operational procedures, and eliminating redundant, time-consuming procedures, the support capability of the base Fuels Management Branch will be greatly enhanced.